Measurement Process

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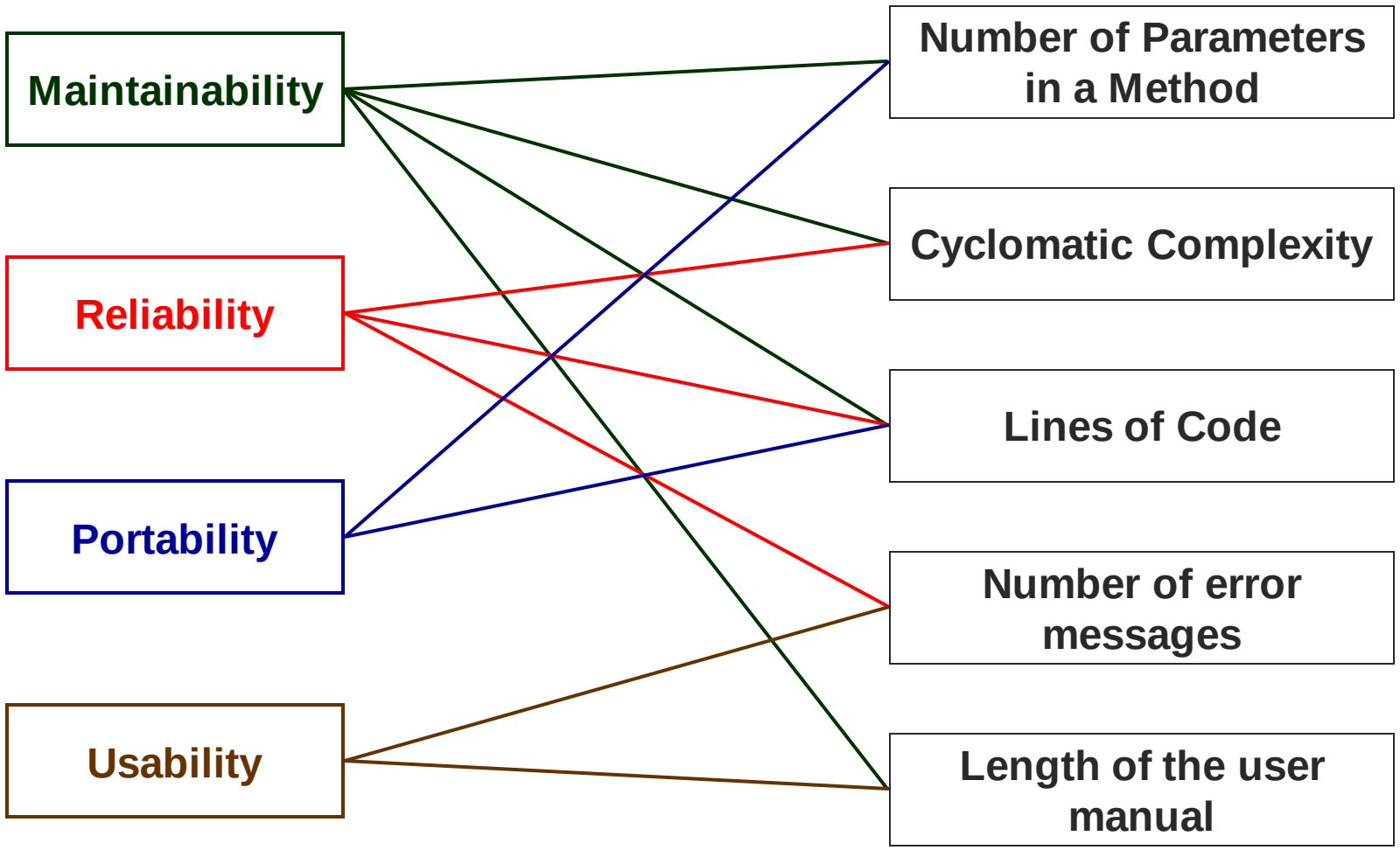
Major Challenge

- It is usually impossible to directly measure an external quality attribute
  - Software metrics usually quantify only internal attributes (or factors)
- Examples of quality attributes
  - Maintainability
  - Usability
  - Reliability

Quality Models

- They relate internal attributes to external ones
  - Internal attributes are easier to be measured
- Relationships in quality models must be clear and valid, otherwise the model is useless

Example of Quality Model



Validity of Quality Models

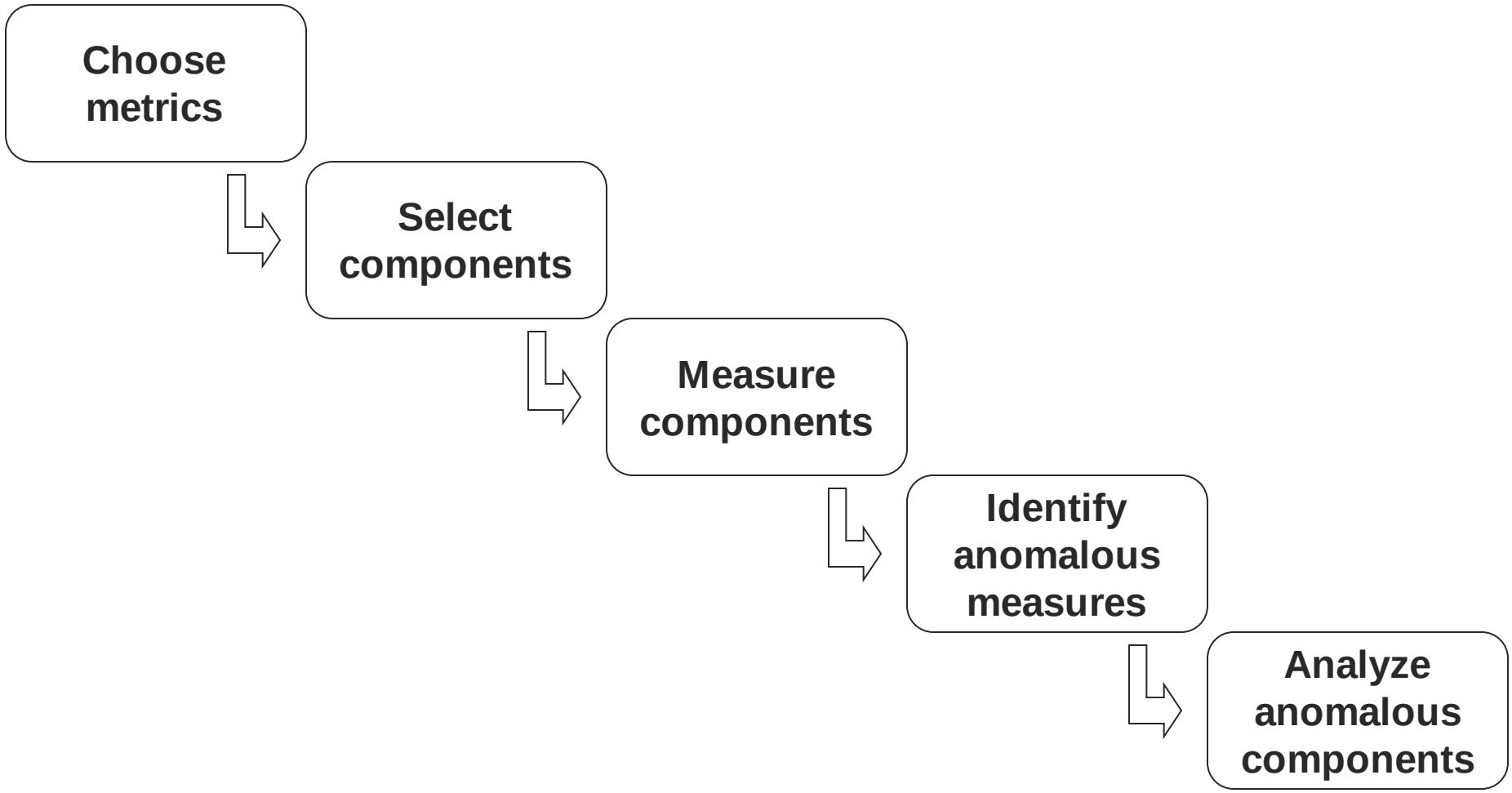
- At least three conditions must be verified in quality models
  - An internal attribute must be precisely measured
  - Internal attributes must be linked to external attributes
  - Relationships must be valid and understood

Activities in the Measurement Process

Measurement Activities

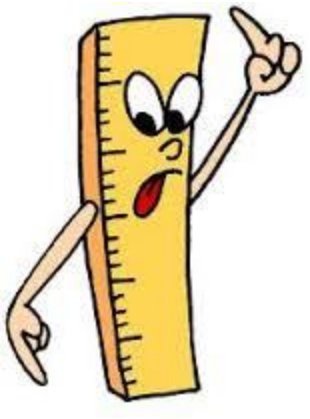
- The five main activities in the measurement process are
  - Choose the metrics to be collected
  - Select the components to me evaluated
  - Measure internal attributes of components
  - Identify anomalous measures
  - Analyze components with anomalous measures

Measurement Process Model



Choosing Metrics

- In this activity, you may want to use the GQM method
  - *Goal-Question-Metric*
- Questions are formulated based on a more abstract goal
- Metrics are chosen to answer each question



The GQM Method

- Goals
  - They define what the organization wants to improve (e.g., productivity)
- Questions
  - They refine each goal to a more quantifiable way (e.g., how can we increase the amount of code we produce?)
- Metrics
  - They indicate the metrics required to answer a question (e.g., current LOC per developer)

Selecting Components

- It might not be necessary (or desirable) to measure the whole system
- Selection strategies
  - To choose a subset of representative components
  - To choose those components which seem to be critical in the software system

Applying Metrics

- The selected components are measured
  - Measures are related to quality attributes (e.g., by means of a quality model or GQM)
- Measurement tools can be integrated with de development environment

Focusing on Anomalous Measures

- After measures have been collected, you can compare them
  - Historical data may be required in this step

- The analysis should focuses on anomalous values
  - That is, values too high or too low for a particular metric

Analyzing Components

- If a component has anomalous measures, it has to be further analyzed
  - An manual inspection process decides if a problem does exist in that component
- An uncommon value does not always mean a problem

  - Analysis of measurement is not easy
  - It may require statistic methods

Example (Excel File)

- Measuring several versions
  - Static software metrics collected in Health Watcher
- Metrics
  - VS: Vocabulary Size
  - CBO: Coupling Between Object Classes
  - LCOM: Lack of Cohesion over Methods
  - DIT: Depth of Inheritance Tree
  - NOC: Number of Children
  - LOC: Lines of Code, etc.

Bibliography

- Ian Sommerville. **Software Engineering**, 9th Edtion. Pearson Education, 2010.
  - Section 24.4 Software Measurement and Metrics